Danger points, complications and medico-legal aspects in endoscopic sinus surgery

By: Nuha alhamamah
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Danger points, complications and medico-legal aspects in endoscopic sinus surgery

Abstract

Endoscopic endonasal sinus surgery represents the overall accepted type of surgical treatment for chronic rhinosinusitis. Notwithstanding raised and still evolving quality standards, surgeons performing routine endoscopic endonasal sinus surgery still face critical complications. For instance, complications in 5% and
# Classification of complications in endonasal sinus surgery

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Classification of complications in endonasal sinus surgery

1. Adverse events”: may resolve spontaneously, easy to handle.

2. Grade A complication (”minor complication”): leads to an additional surgery, without permanent harm.

3. Grade B complication (”major complication”): irreversible damage.

4. Grade C complication (”disastrous complication”): death.
Classification of complications in endonasal sinus surgery

a) “Minor complication”: intraoperative controllable without consequences.

b) “Major complication”: controllable during surgery or in revision surgery, without permanent harm.

c) “Serious complication”: high risk of permanent harm.
Conditions that may increase the risk of a complication

- Advanced sinus disease with the need of a more extensive approach.
- Revision surgery.
- Patients with severe comorbidities.
- Patients with anatomical abnormalities
Conditions that may increase the risk of a complication

- Missing anatomical landmarks increased risk of intraoperative bleeding.
- Lack of conception/manual experience of the surgeon.
- Surgical approaches from the right side (by a right handed surgeon).
Minors” complications

1) Damage of the lamina papyracea – orbital emphysema, preseptal bleeding
Damage of the lamina papyracea

- The **most common minor complication** of endonasal sinus surgery derives from defined damages of the lamina papyracea.

- This may occur for instance while performing uncinectomy or maxillary antrostomy, preferably on the right side.

- These injuries are more frequently observed in less experienced surgeons.
Maxillary sinus hypoplasia (4%).

Hypoplasia of the ethmoid (10%)

Congenital or acquired defects of the medial orbital wall are a potential risk (0.5%)

Natural dehiscence of the lamina papyracea with prolapse of orbital content. The site of dehiscence is always close to the ethmoid bulla and anterior to the basal lamella of the middle turbinate
How to confirm it?

Repeated careful application of pressure to the outside of the patient's eyeball produces corresponding movements of the bulging fat.

A method to prove whether the atypical tissue in the surgical field is prolapsed orbital fat, is to place it into water and see if it swims (fat swims in water, ulterior tissue does not).
How to manage

- **Intraoperative:**
  - Avoid suction and shaver.
  - The damaged site can be covered with a silicon layer, this layer can be temporarily left in place.
  - The surgery can be continued.
How to manage

- Postoperatively:
  - The condition of the eye needs to be observed.
  - Instruct the patient not to blow his nose or undergo physical activities.
  - Anibiotic prophylaxis ??
Orbital emphysema

- Postoperative emphysema of the eyelid may occur following nose blowing, sneezing or after anesthesia with mask ventilation.

- History of a fracture or a surgical defect in the lamina papyracea.

- Mostly the emphysema develops in the upper eyelid.

- Orbital emphysema usually resorbs within a week, therapy measures are conservative.
How to manage

- The patient is advised to avoid nose blowing and sneezing.
- Regarding patients with a history of allergies, antihistamines may be prescribed if necessary.
- Antibiotics??
- An ophthalmic exam is recommended, but is not mandatory in every case.
One reported case of progressive emphysema of the entire face and throat due to an atypical injury of the dorsal nasal cavity (during nasal packing) was reported.

Tension pneumo-orbit

Loss of vision or diplopia is rarely associated with orbital emphysema
“Minor” complications

2) Uncomplicated bleeding of the mucosa
Bleeding in the surgical area hinders visibility, hence may cause delays, an improper performance of the operation or even surgical complications.

In principle, different vascular systems, subject to different hemodynamic systems, are the origin of the bleeding.

The average blood loss varies substantially, in each individual case as being between 50–100 ml.
The mean arterial pressure is essential for arterial bleeding, whilst for venous bleeding it is the pressure in the venous vascular territory. For capillaries the blood flow in the respective vascular bed of the capillary is the determining factor.
About 5% of routine procedures are persistently disturbed by a hemorrhage and in about 1.4% the procedure is cancelled.

Bleeding occurs more frequently in patients simultaneously undergoing a surgical procedure on the inferior turbinate; polypoid sinusitis or revision surgeries are associated with greater blood loss.
The rate of peri- or postoperative bleeding is supposed to be around 2% altogether; transfusions were required in about 0.2%.

A preoperative systemic (e.g. 30 mg/day prednisone for 5 days) and possibly also topical cortisone treatment can lead to a clear and unobstructed operating field with less bleeding which consequently reduces the duration of surgery.
How to avoid such complication
Preoperative

Medications history (Vitamin K antagonists or platelet aggregation inhibitors non-steroidal inflammatory drugs).

Herbal or alternative medical substances, as for example ginkgo, garlic or ginseng, may also contribute to increase bleeding according to pharmacological literature.
Intraoperative measures

- **Topical vasoconstriction**
  - Cocaine, phenylephrine.
  - Epinephrine (usually 1:1,000) are generally applied.
  - The calculated risk of side effects was estimated to be 0.05% and it was concluded that the topical application of epinephrine 1:1,000 can only be deemed to be safe in adults without previous cardiac damage.
  - For children, 0.05% oxymetazoline is used, with a subsequent use of 0.1% oxymetazoline, in justified cases epinephrine 1:2,000 is used.
Intraoperative measures

- Topical vasoconstriction
- Exposed optic nerve!
- An accidental injection of the standard solution into the mucous membrane.
- Combined application of topical and injected epinephrine
Intraoperative measures

- Adrenaline - injection:
  - injection (epinephrine 1:100,000/1:200,000) vs sodium-chlorine injection or to the application of additional topical decongestion
  - In some cases, a temporary drop in blood pressure as well as transient arrhythmias have been observed.
Intraoperative measures

- Adrenaline - injection:
  - In several cases following bilateral injection, a distinct cardiovascular response was noticed (1:200,000 epinephrine, 2–3 ml), accompanied by an increase of the average arterial blood pressure.
  - Relevant side effects, however, are extremely rare
Intraoperative measures

- **Anesthesia – controlled hypotension:**
  - The aim is a MAP of 50–60 mmHg or 80 mmHg for elderly people.
  - A reduction of the systolic blood pressure to less than 100 mmHg.
  - At the same time, the mean arterial blood pressure should not be lowered to less than (66% or) 85% of the initial value.
Intraoperative measures

- Anesthesia – controlled hypotension:

  - There is cause for concern of cognitive deficiencies developing postoperatively.

  - Severe complications including organ ischemia have been observed in 0.02–0.06% of cases. However, there should be no risk for healthy patients (ASA I) in general.
Intraoperative measures

- The recommendation is to inhibit each reflex tachycardia and to aim for a pulse rate of 60 per minute.

- The administration of beta inhibitors (metoprolol), only led to a short positive effect regarding bleeding.

- A total intravenous anesthesia (TIVA) provides the surgeon with a comparatively better surgical area.
Intraoperative measures

- **Propofol** reduces cardiac output and might contribute to a better objective local anemia (eventually via an alpha-adrenergic mediated vasoconstriction). However, if the operation lasts longer than 45 minutes, adverse effects on the platelet function become apparent.
Intraoperative measures

- In order to suppress capillary bleeding, the insertion of 3% H2O2 by means of saturated cotton wool strips is recommended.

- Tranexamic acid (10 mg/kg) was administered intravenously at the beginning of the sinus surgery, leading to a significant improve of the anemia in the surgical area.

- Rinsing the surgical field using 40 degree hot water is also described as helpful.
Intraoperative measures

 Packing…
 Absorbable material
How to manage

- Identify the source of the bleeding tissue substrate by means of optimizing the position of the suction.
- Afterwards, selected coagulation is performed.
- In case these measures fail, nasal packing is applied.
Localized injuries of the cavernous sinus:

can be reliably controlled e.g. by means of insertion of gelatin and thrombin (Floseal®), compressing the substance for two minutes]. Alternatively, other hemostyptica (e.g. microfibrillar collagen, polyacetyl-glucosamine fibers) are available.
“Minor” complications

3. Uncomplicated liquorrhea
Epidemiology

- Small and isolated CSF fistulas, which are treated at once successfully, count statistically as “minor complication”

- According to literature the rate of manifest, clinical relevant CSF fistulas, is around 0.2–0.8%
ANATOMY

The weakest part of the anterior skullbase is located in the area of the lateral lamella of the olfactory fossa. Here, the bone is often only 0.05 mm thin.
Anatomic variants of the rhinobasis favor injuries

a. Position of the ethmoid roof beneath the roof of the orbit.

b. Asymmetry of the ethmoid roof.

c. Asymmetry regarding the height of the ethmoid roof (in 2/3 the right side is lower than the left).

d. Deep position of the cribriform plate, i.e. high lateral lamella of the olfactory fossa.

e. Larger angle between the skull base and the horizontal line through the sagittal plane.
Localization

- The most common site of erosion is where the middle turbinate passes into the skull base near the ant. ethmoidal artery.
- Roof of the ethmoid, in case of a relatively high located maxillary sinus, is a predisposed site.
- Injuries in the central or anterior area of the ethmoidal roof, 0.5 to 1 cm behind the surgical opening of the frontal recess.
- RT SIDE.
Presentation

- Clear liquid flows into the operating field
- In other cases the fistula remained unnoticed at first; some studies state a percentage of 50%
- Meningitis
Diagnosis

1. Primarily nasal endoscopy is performed. Obvious nasal secretion is tested

2. beta 2 transferrin VS beta-trace protein (False positive) (false-negative)

3. High resolution CT using thin sections in axial (sphenoid sinus, posterior wall of the frontal sinus) and coronal plane (rhinobasis)
4. Intra-thecal fluorescein

- Sensitivity 74%–96%, specificity 100%
- False-negative
- Not approved (i.e., off label-use)
- Ophthalmologist & neurological consultation
- Dilution is 0.1–1 ml of 10% intravenous fluorescein in 10 ml of the patient’s own CSF, which is infused very slowly
Diagnosis

- Patients are instructed to lie with the head tilted low for 2 hours after injection.
- Bed rest is prescribed for 12 hours, the patient is supervised for 24 hours.
- The yellowish color of the fluorescein is mostly visible with an endoscope,
- Up to 20 hours after injection the dye remains visible in the CSF
Side effects

Contraindication:

- papilledema
- massive intracranial tumor
- purulent meningo-encephalitis
- severe craniocerebral trauma.
In literature an alternative method of topical application of fluorescein without lumbar puncture is introduced. Here 5% of fluorescein solution are administered to suspicious areas in the operative field, expecting to turn yellow or green when binding with cerebrospinal fluid.
Diagnosis

5. CT cisternograms and MRI as MR cisternography may be used.
Surgical management

- Iatrogenic cerebrospinal fluid fistulas are usually below 3mm in size, in some cases 2–20 mm.

- Surgical treatment should be pursued even with small defects.

- This recommendation is based on observations in traumatology and on experience that only in 1/3 of cases with conservative treatment the scar is rigid enough.
Surgical management

- Localization
- small defects vs larger defects
Surgical management

Small defects:

- Free autogenous mucus grafts are preferred
- Onlay/overlay technique
- The borders of the defect need to overlap at least 4mm even in case of small leaks
- The correct orientation and position of the free mucosa graft has to be carefully taken into account – to avoid an intracranial mucocele
Surgical management

- Larger defects:
  - above 5 mm in diameter
  - closed in several layers, partly with cartilage or bone.
  - Fibrin glue does not have to be applied in every case.
  - Regarding certain allogeneous material (acellular dermis) a prolonged healing and crusting phase has to be expected.
Surgical management

Anesthetic management needs to consider the circumstance, hence avoid an increase in CSF pressure or pressure of the upper airways (no positive pressure ventilation, deep extubation technique, avoiding coughing and straining).
Post-operative care

- Nasal packing for 3–7 days.
- Restricted bed rest to 1–5 days, and they are released after 3–7 days.
- Monitor the state of consciousness
- Elevate head of bed (40 to 70 degree)
- Advised not to lift heavy objects and not to blow his nose for some time.
- Antiallergics, laxatives and antacids are prescribed.
Post-operative care

- CT?

If an instrumental penetration into the intracranial space as part of the genesis of the CSF fistula could not be clearly excluded, a CT scan is performed emergently and mandatory

- MRI

- fluorescein test
Post-operative care

- **ANTIBIOTICS?**
  Indication, type, duration

- **Lumbar drains?**

**USEFUL:**
- increased intracerebral pressure
- closure of large defects
- following revisions.
Prognosis

- A meta-analysis showed no significant difference regarding success rate, stating that revision surgery is generally performed in about 90% of all cases, for small defects to up to 97%.

- Recurrence of fistulas is frequently observed in patients with an increased CSF pressure.
Prognosis

Active CSF fistulas may result in meningitis perioperative complications are reported, such as headaches, seizures, secondary sinus-itis, intracranial/subdural haemorrhages or abscesses, vision problems or cavernous sinus thrombosis.

Postoperative olfactory dysfunctions, however, were reported with a considerably higher frequency in individual case series 17%.
If an iatrogenic fistula is treated immediately and adequately without any of the above mentioned complications, medico-legal consequences occur merely as an exception.

Introduction of the vascular pedicle intranasal mucoperiosteal flaps and to a consistently multilayered defect closure results in reduction of CSF fistula recurrence to 5%.
Prognosis

- Low flow vs high flow fistulas.
- In larger defects after extended skull base surgery, local vascular pedicled flaps (nasoseptal flaps, flaps from the middle or inferior turbinate or, in special cases, also local flaps (pericranial flap, temporoparietal flap, palatal flap are available. These flaps are superior to free grafts. The dorsal pedicled nasoseptal mucosal flap is most frequently used
Prognosis

- Unsuccessful reconstructions:
  - Insufficient localization of the defect
  - Previous surgeries
  - History of craniotomy or radiotherapy
  - Existing intracranial infection
  - Increase in cranial pressure
“Minor” complications

4. Synechiae, “missed ostium sequence”, unstable middle turbinate with lateralisation
Synechia

Postoperatively the individualized anatomy is distorted in the process of healing.

Intranasal wounds generally undergo secondary healing.

The respective prospects of healing are less favorable for certain patient groups e.g. asthmatics or patients suffering from “aspirin triad”
Synechiae represent a more complex problem. Occurring in about 10% of cases, they are frequent, however, in most cases (60–90%) functionally unapparent.

In other cases, symptomatic synechiae with an incidence of 1–3% are documented.

After tumor surgery (5%)

after transsphenoidal skull base surgery (about 9%)
How to avoid Synechia

For the purpose of prevention, placing mucosal grafts onto the exposed bone in order to avoid a reactive ostitis with secondary thickening of the bone, is recommended.
“missed ostium sequence” develops in case of suboptimal fenestration of the maxillary sinus via middle meatus with a untouched, separate and insufficient natural maxillary ostium (covered by remains of the uncinate process).

Treatment comprises the microsurgical unification of the two ostia with excision of the uncinate process.
Unstable middle turbinate with lateralisation

- After an ethmoidectomy, in 10–40% of cases

scar-induced lateralization of a detached vertical lamella of the middle turbinate

The use of a shaver prevents this development
Unstable middle turbinate with lateralisation

- in case of an evidently fractured or destabilized vertical lamella during surgery. Nevertheless, many authors approve of con- serving the turbinate.

- In individual cases, an "empty nose" syndrome has developed after resecting the middle nasal turbinate.
Unstable middle turbinate with lateralisation

In contrast, no negative effects of a routine anterior 1/3 resection

The rate of recurrent nasal polyposis was lower and there was a tendency of improved olfactory function.

The number of lateral synechiae also decreased, although the synechiae developing during therapy in spite of partial resection were more challenging.
How to prevent scar-induced lateralization (floppy turbinate)

- Special supporting septum foils (splints) for about 14 days
- Establishing a small, “controlled synechia” to the nasal septum, possibly using fibrin glue. A secondary olfactory impairment was not observed.
- Fixation of the lamella via suture to the nasal septum
How to order to prevent scar-induced lateralization (floppy turbinate)

- Fixation of the lamella with customary clips introduced into an artificial pouch in the mucous membrane of the nasal septum by means of a branch

- Absorbable, cortisone-releasing stents which may be inserted into the ethmoid labyrinth are under development
“Minor” complications

5- Hyposmia
Mechanism of hyposmia post FESS

- Direct mechanical trauma
- Progressive inflammation of the mucosa
- By a postoperative modification of the nasal air passage.
- "mobilization" of the turbinates
Preoperatively, about 17% of the routine patient population suffering from chronic rhinosinusitis is affected by olfactory disorders.

16% of patients suffering from preoperative olfactory disorders were not aware of their impairment.
For medico-legal reasons, these circumstances suggest that a preoperative measure of olfactory ability should always be performed.

For rough orientation purposes, the rate of a postoperative arising hyposmia is indicated at about 3%, whilst the rate of a postoperative smell deterioration is estimated at about 9%.
“Minor” complications

6. Atrophic rhinitis
Pathogenesis

- Develop after extensive and usually recurrent sinus surgeries, with removal of larger areas of mucous membrane and resection of the middle or superior nasal turbinate.

- The latter group of patients represent about 10%
Symptoms

- paradox nasal obstruction
- Dyspnea
- Dry feeling in nose and pharynx
- Hyposmia
- Depression
- Pain

develops with a latency period of several years
In routine surgery of chronic rhinosinusitis, the rate of postoperative atrophic rhinitis is roughly between 0.08 and 0.4%.

Rhino-neurosurgical procedure transsphenoidal approaches, a rate of 10%

Therapy is mainly conservative, based upon intensive moistening, local care with the administration of ointments or oils.
“Minor” complications

7- Nerve injuries
infraorbital n., alveolar n.
Mechanism of injury

Electrosurgical measures are applied in the maxillary sinus, an injury of the infraorbital n. at the roof of the maxillary sinus may result.

Bony dehiscences in the channel of the infraorbital nerve increase the risk of such a complication.

Postoperative sensibility disorders of teeth or lips and cheeks respectively is about 3%
In 3/4 of all cases, complications occur postoperatively, such as cheek swelling, face pain, numbness of the face or teeth or even paresthesia.

In about 30% of patients, these complaints remain in part permanently, most likely as a local dysesthesia.
In transpterygoid rhino-neurosurgical approach, amongst others, the maxillary or the vidian n. can be damaged.

Temporary reduction of the lacrimal secretion (xerophthalmia, postoperative incidence 12–30%) and reduction of the moistening of nasal mucous membranes.
Severe or threatening complications

1- Orbital haematoma
The incidence of orbital hematomas is around 0.1%

It is a clinical diagnosis.
arterial bleeding

- It appears intraoperatively OR in the recovery room.
- Literature points out rare cases of a hematoma occurring hours later.
- The most frequent cause is an injury of the anterior ethmoidal artery at the medial anterior ethmoid roof with a secondary retraction of the bleeding artery into the orbit.
Presentation

- progressive proptosis with chemosis
- pain
- congestion of the conjunctival vessels
- ecchymoses or subconjunctival bleeding develops.
Presentation

- Ocular motility is disturbed
- the pupil reaction is reduced or absent pupil
- visual field loss and loss of vision.
Examination

- During palpation, a distinct resistance of the orbital tissue is felt and an increased intraocular pressure is noticed.
- Fundoscopic findings are: pulsation of the central retinal artery, central retinal artery occlusion, retinal edema, venous congestion, macular edema.
Complication

- A pressure-related occlusion or a spasm of the ophthalmic or the central retinal a., a direct compression of the optic nerve or discontinuation in the immediate vascularization of the optic nerve

- According to literature, in case of imminent loss of vision, a maximum duration of about 90 minutes
Prognosis

- It is known from traumatological literature that the risk of permanent blindness with manifest retrobulbar hematoma with accompanied loss of vision is approx. 50%.
- Vision recovery takes place within a time frame of approx. 30 hours.
- Prognosis for younger patients is better
Management

- Cooling compresses are applied.
- The top end of the bed is raised.
- An emergency ophthalmic consultation is recommended.
- Nasal packing is removed.
- Intraocular pressure is measured.
- The digital ocular massage.
The indication for a surgical approach is often discussed in literature on the basis of an objective measurement of (IOP).

However, in daily routine the indication mainly takes place clinically, the pressure conditions can be estimated via comparative bilateral palpation.
1. CANTHOTOMY & CANTHOLYSIS

- Emergency indication for canthotomy and cantholysis is assumed for an IOP above 40 mmHg.

- In different references, surgery is necessary if the intraocular pressure (IOP) is higher than the mean arterial pressure minus 20 mmHg.
Surgical intervention

- Lateral canthotomy results in a reduction of the intraocular pressure by approx. 14 mmHg,
- Cantholysis leads to a decompression of approx. 30 mmHg
- An orbital decompression may cause an additional pressure reduction of 10 mmHg. With complementary measures (e.g. orbital septolysis), the orbital pressure (OP) can be reduced by approx. 70%.
Lateral canthotomy & cantholysis

Lateral Canthotomy
2. A medial decompression of the orbit via an endonasal approach. The lamina papyracea is removed and an incision is made in the periorbit extending posterior to anterior. Postoperative enophthalmos may occur.
Surgical intervention

3. The medial decompression of the orbit via an external or a transcaruncular approach

4. An exploration or decompression of the lateral orbit

5. An infraction of the orbital floor respectively, resection of the orbital floor, e.g. via a transoral or transconjunctival approach.
Surgical intervention

6. In case of extreme emergency, the ophthalmologist may recommend an anterior chamber paracentesis in order to release aqueous fluid e.g. in case of a blockage of the central retinal artery
Medical management

- Mannitol
- Cortisone
- Acetazolamide
- Timolo eye drops
- The administration of antibiotics is recommended

In principle, there is no solid proof of effectiveness regarding conservative treatment.
CT
MRI
Major complication

2. Reduced vision, visual field defects
Anatomy

- The optic n. often bulges into the superior-lateral wall of the sphenoid sinus
- In 8% of cases, the canal of the optic n. protrudes into the sphenoid sinus by half of its diameter
Anatomy

In 1% of cases, with a large lateral recess of the sphenoid sinus, it passes partially “freely” through the sphenoid sinus or through a posterior (sphenoethmoidal) ethmoidal cell.
Anatomy

- The average bone thickness in the direction of the sphenoid sinus is 0.3 mm, however, in about three quarters of all cases, it is said to be 0.5 mm.

- Bony dehiscences are observed in 4–8%.
Perioperative blindness in paranasal sinus surgery occurs in case of:

- Direct injury of the nerve
- Drug-induced interruption of local blood supply
- Hematoma
- In extremely rare cases also by an emphysema, or in case of damaging the central nervous system, as, for instance through meningitis
How to manage

- After every postoperatively noticed or supposed visual reduction, an ophthalmological emergency consultation should occur.

- Imaging (e.g. MRI) is strongly recommended
If the optic n. is visibly cut through, there is no specific treatment.

If neurapraxia or a hematoma is suspected, a high dose corticosteroid treatment is followed out (e.g. intravenous dexamethasone 0.5–1 mg/bodyweight).

In specific cases, decompression of the nerve may be discussed – however, its benefit has not been proven yet.
Ischemic optic-neuropathy:

Loss of vision or visual field reduction emerges immediately or with a delay of several hours to days. MRI displays a vaguely defined and swollen optic n. with otherwise normal structures.
A decompression of the optic nerve does not always seem appropriate.

Administration of cortisone (e.g. 4 x 250 mg Methylprednisolone per day for 3 days) is subject of controversy.

An immediate normalization of blood pressure and hemoglobin (by means of transfusions) seems essential.
2 Case reports

One underwent decompression of the orbit and periorbital incisure, high dose corticosteroid treatment (Prednisolone 1000 mg intravenously) and antibiotic was initiated. Within a period of 4 weeks the condition of the patient improved.

The other case the optic n. was also decompressed and the subsequent improvement occurred within 6 days.